SIMULATION OF THE TROPICAL AIR-SEA COUPLED SYSTEMS IN THE NEW NCEP COUPLED FORECAST MODEL

Jiande Wang*, Sudhir Nadiga*, Wanqiu Wang*, Suranjana Saha**,
Hua-Lu Pan** Glenn White** and David behringer**
*Science Application International Corporation at National Centers for Environmental Prediction, Camp Spring, Maryland, 20746
** Environmental Modeling Center, National Centers for Environmental Prediction, Camp Spring, Maryland, 20746

A new global coupled atmosphere-ocean forecast model (CFS03) has recently been developed at National Centers for Environmental Prediction (NCEP). The atmospheric component of CFS03 is the latest T62L64 NCEP operational atmospheric global forecast system model updated with versions of the physics of solar radiation, boundary layer vertical diffusion, cumulus convection, gravity wave drag and cloud water/ice scheme compared with the original one. The ocean component of CFS03 is GFDL MOM3 with roughly 1x1 degree horizontal resolution (the meridional resolution is enhanced around the equator) and 40 layers in vertical and standard physical package. In the coupling, the atmospheric and ocean models exchange fields once a day and no flux correction is applied. The model climatology is in good agreement with observations. Details on CFS03 configuration and modeled climatology can be found from Wang et al. (2004). Here we focus on CFS03's simulation on the tropical air-sea coupled systems from the 32-years free run.

In the tropical Pacific, the model simulation successfully captures the ENSO signal. EOF analysis of the simulated SST (Fig. 1) shows that the first mode represents the mature stage of ENSO while the second mode represents its transition stage. Their spatial patterns and explained variances are in good agreement with corresponding results from the NCEP Global Ocean Data Assimilation System (GODAS). The EOF analysis of the upper ocean heat content also yield reasonable agreement with GODAS, although a weak cold bias south of the cold tongue was detected. This bias can be traced back to the unrealistically representation of stratus clouds and shortwave penetration in the coupled system.

In the tropical Atlantic, the meridional dipole structure is well represented in the first EOF mode of SST variability. The Indian dipole also appears in the simulation although the negative SST anomaly in the western Indian Ocean is too strong, probably because of the modeling errors in the Indonesia through-flow.

Currently we are performing a 23-year long hindcast (1981-2003) with fifteen ensemble members to fully test CFS03 before its final implementation into operation. Primilary results show very encouraging forecast skills in large-scale phenomena such as ENSO and U.S precipitation and surface temperature. The Nino3.4 index from hindcast with April and October initial conditions (Figure 2) indicates that most of the ENSO events have been successfully represented in the CFS03 system.

Corresponging author address: Dr. Jiande Wang, 5200 Auth Road, room 807, Camp Spring, MD 20746. email: jiande.wang@noaa.gov

Reference:
Wanqiu Wang, Suranjana Saha, Hu-Lu Pan, Sudhri Nadiga and Glenn White, 2004: Simulation of ENSO in the new NCEP coupled forecast model (CFS03). Submitted to Bull. Ameri. Meteo. Soc.

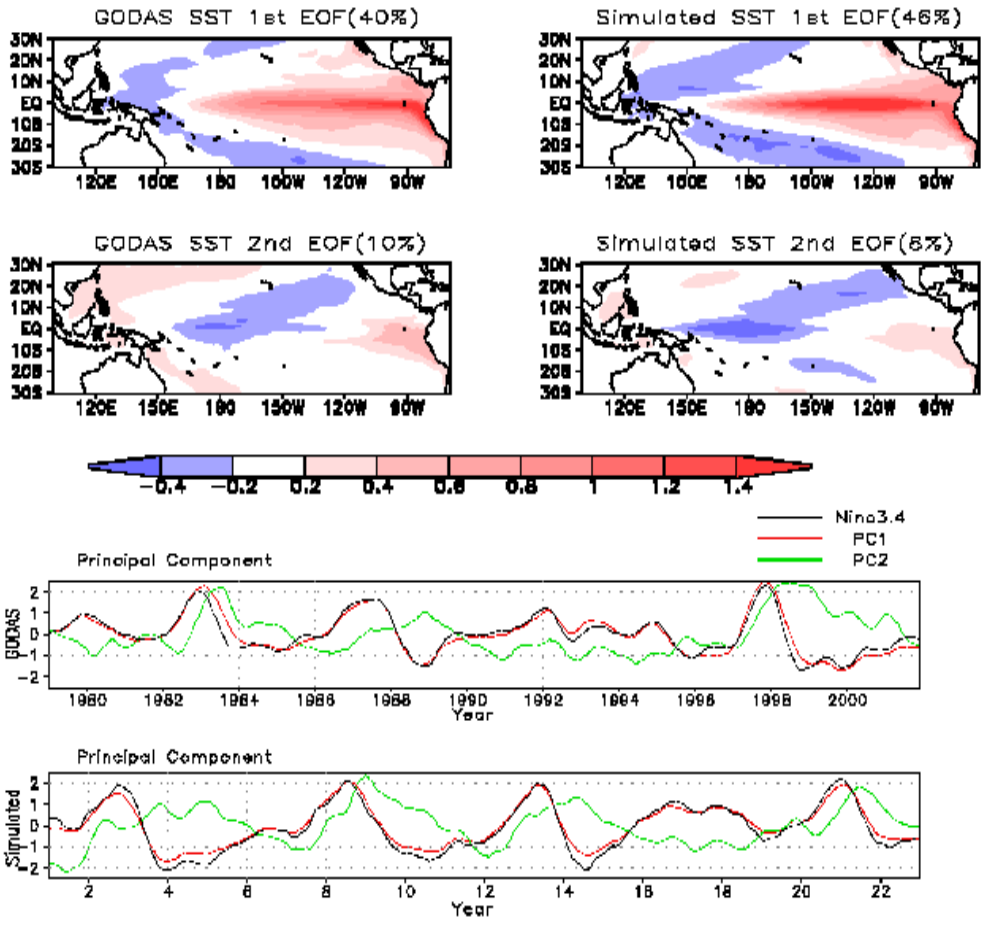

Figure 1: Upper panel: First and second EOF modes for SST variability from GODAS (left panels) and CFS03 free-run (right panels). Explained variances are labeled in the top of each panel. Unit is in degree centigrade. Lower panel: corresponding time series for first and second modes with 6-month running average. Black line is Nino3.4 index from GODAS.

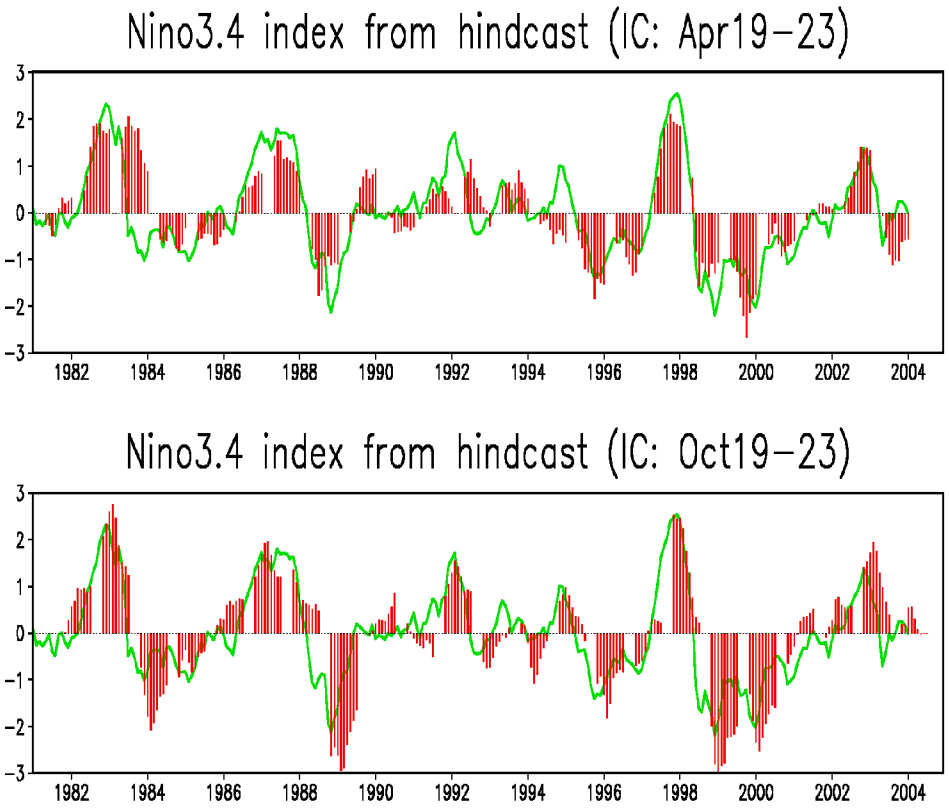

Figure 2: Nino3.4 index from hindcast with initial conditions from April 19-23 (upper panel) and October 19-23 (low panel). Red bars are five-member (day 19-23) average. CFS03 is run for nine months for each year (1981-2004) so the red bars are not continuous. Green line is Nino3.4 index from GODAS. All unit are in degree centigrade.